REMARKS

Claims 1, 3-8, 11, 13-14, 16-18 are currently pending in the present application, with claims 1 and 7-8 being written in independent form. Claim 1 has been amended for clarity. Support for the amendments may be found throughout the original application. Claims 2, 9-10, 12, 15, and 19-20 have been cancelled without prejudice or disclaimer, with claims 19-20 having been previously cancelled. Claims 7-8 remain withdrawn from consideration. Thus, no new matter has been introduced into the claims.

Claim Rejections under 35 U.S.C. § 103 (Bokova + Irle)

Claims 1-6 and 9-18 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over *"Laser-Induced Effects in Raman Spectra of Single-Wall Carbon Nanotubes,"* Quantum Electronics, Vol. 33, No. 7, pp. 645-650, 2003 (Bokova) in view of *"Theoretical Study of Structure and Raman Spectra for Models of Carbon Nanotubes in Their Pristine and Oxidized Forms,"* J. Phys. Chem. A, Vol. 106, pp. 11973-11980, 2002 (Irle). Applicants respectfully traverse this rejection for the reasons below.

Cited Art Fails to Disclose or Suggest All Claimed Limitations

Without conceding as to any of the Examiner's assertions that are not specifically addressed herein, Applicants note that the combination of Bokova and Irle fails, as a preliminary matter, to disclose or suggest all the limitations of the method of structure control according to amended claim 1.

The Examiner asserts that Bokova teaches irradiation of light having an energy density of 10 kW/cm^2 so as to selectively oxidize a carbon nanotube based on p. 648, left col., ln. 4-7, of Bokova which recites, "we have found by the method of Raman

spectroscopy that the threshold temperature of selective oxidizing annealing of HipCO nanotubes by laser radiation depends on the nanotube *diameter* . . ." Applicants respectfully disagree.

This recitation merely teaches that a threshold temperature of the selective "oxidizing annealing" of HipCO nanotubes by laser irradiation is dependent on the diameter of the nanotube. Applicants note that the "oxidizing annealing" in Bokova, as shown in Irle (subsequently discussed), describes a state in which although a form of a carbon nanotube is basically maintained, a certain amount of oxygen atoms is included or adsorbed in the carbon nanotube. More specifically, in Irle, (i) a Raman spectrum is calculated before oxidizing the carbon nanotube; (ii) the carbon nanotube is oxidized, (iii) a Raman spectrum is calculated after the carbon nanotube is oxidized, and (iv) a change in Raman spectrum is calculated before the oxidation and after the oxidation. The result of these theoretical calculations is shown in FIG. 4 of Irle. Referring to FIG. 4 of Irle, the graphs in the left column show the Raman spectra of the carbon nanotubes before oxidation, while the graphs in the center and right columns show the Raman spectra of the carbon nanotubes after oxidation. Furthermore, the structure of the carbon nanotubes of the graphs in the top line in FIG. 4 is illustrated in FIG. 1, the structure of the carbon nanotubes of the graphs in the middle line in FIG. 4 is illustrated in FIG. 2, and the structure of the carbon nanotubes of the graphs in the bottom line in FIG. 4 is illustrated in FIG. 3. Based on the figure captions of FIGS. 1-3 and the associated descriptions in Irle[1], it is clear that the "oxidizing annealing" merely adds oxygen atoms to the carbon nanotube and is not

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1 *Irle*: p. 11975, right col., ln. 36-41 (stating in regard to the structure in FIG. 1 that "When two oxygen atoms are added to 1_6 . . ."); p. 11976, right col., ln. 12-15 (stating in regard to the structure in FIG. 2 that "Upon double 1,2- and 1,4-oxidation leading to

a process that oxidizes and removes the carbon nanotube. Stated more clearly, the oxidized carbon nanotube is not removed by the "oxidizing annealing." Therefore, the combination of Bokova and Irle does not disclose the selective oxidation and removal of the carbon nanotube by laser irradiation.

Moreover, the method disclosed in Bokova is a method for oxidizing the carbon nanotube regardless of the wavelength of the irradiated electromagnetic wave, and is a method that is completely different in principle to the method according to claim 1 of the present application.

For instance, the method according to claim 1 of the present invention is a method in which, upon two hours irradiation with an electromagnetic wave with an energy density of 10 kW/cm^2, a low-dimensional quantum structure having a density of state "**resonating with the wavelength**" of the irradiated electromagnetic wave is **selectively and completely oxidized** (as CO_2 or CO) so as to remove the low-dimensional quantum structure from the mixture.[2]

In comparison, FIG. 3 of Bokova illustrates that only the narrow carbon nanotubes are oxidized and removed (while the thicker nanotubes remain) upon increasing excitation intensity of an irradiated laser. Stated more clearly, Bokova teaches that irradiating a laser having a higher laser power causes the carbon nanotube to be oxidized, regardless of the wavelength of the irradiated laser.

Furthermore, FIG. 4 of Bokova illustrates that as the substrate temperature rises, only the narrow carbon nanotubes are oxidized and removed. Namely, FIG. 4 of Bokova shows that just the narrow carbon nanotubes will be selectively oxidized and

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products . . ."); and p. 11977, left col., ln. 19-23 (stating in regard to the structure in FIG. 3 that "Upon examining the oxidation products 3_12_O12 . . .").

2 *E.g., Applicants' published application (US 2007/0004231)*: par. [0046].

removed upon raising the substrate temperature, even if no laser is irradiated. This is because the narrow carbon nanotubes break down with relative ease in situations where the temperature of the sample increases, wherein the increase in sample temperature is caused by the increase in the substrate temperature.

As described above, FIGS. 3-4 of Bokova shows similar results of oxidizing the carbon nanotubes, regardless of the wavelength of the irradiated laser. In FIG. 3 of Bokova, the substrate temperature is raised due to the laser irradiation, and as a result, only the narrow carbon nanotubes are oxidized and removed. In other words, in the method of Bokova, the oxidation of the carbon nanotube is dependent only on the laser power or the sample temperature. Therefore, Bokova shows a phenomenon that occurs independent to the wavelength of the laser. Clearly, the method disclosed in Bokova is completely different in principle to that according to claim 1 of the present application.

Irradiation of light (having an energy density of 10 kW/cm^2) in air is illustrated in FIG. 6 of Bokova. However, FIG. 6 of Bokova only illustrates that a Raman spectrum is measured by such irradiation and does not illustrate that the carbon nanotubes are oxidized and removed by irradiating the light having the energy density of 10 kW/cm^2. Additionally, the Raman spectrum of FIG. 6 of Bokova is merely for the purpose of showing the physical properties of the sample. Stated more clearly, the measurement was carried out under conditions in which no change is caused to the physical property to the sample being measured.

As described above, Bokova neither discloses nor suggests selectively oxidizing and removing a low-dimensional, quantum structure of a specific density of state from a mixture of low-dimensional quantum structures of densities of states "**resonating with the wavelength**" of the irradiated electromagnetic wave, by irradiating the low-dimensional quantum structure with the electromagnetic wave having an energy

density of 10 kW/cm^2 for two hours. Consequently, it would not have been obvious for a person ordinarily skilled in the art to arrive at the method of claim 1 of the present invention on the basis of the method disclosed in the cited art.

As recognized by the Examiner, the Abstract in Irle discloses that, upon oxidation, a measured Raman spectrum is largely reduced at peak intensities. In particular, Irle theoretically explains that oxidation of the carbon nanotube causes a reduction in Raman intensity as compared to the carbon nanotube which has not been subjected to oxidation. Thus, as evidenced by Irle, those ordinarily skilled in the art would readily understand that the Raman intensity will be reduced upon oxidation of a carbon nanotube.

However, although Irle discloses oxidizing a carbon nanotube and confirming the oxidation of the carbon nanotube, Irle *neither* discloses *nor* suggests the selective oxidation and removal of a low-dimensional quantum structure having a specific density of state. For instance, in FIG. 4 of Irle, a Raman intensity of a specific peak is reduced along with the oxidation of the carbon nanotube, and simultaneously a new peak appears. This is due to the fact that, because the oxidized carbon nanotube changes in vibration, a Raman intensity of the peak corresponding to the carbon nanotube yet to be oxidized is reduced, and thus a new peak corresponding to the carbon nanotube which has been oxidized appears. Thus, while Irle discloses confirming that a carbon nanotube changes its frequency of vibration due to the oxidation, there is no disclosure or suggestion as to the selective oxidation and removal of only the low-dimensional quantum structures having a specific density of state.

Therefore, based on the teachings of Bokova and Irle (individually or in combination), it would not have been obvious for a person ordinarily skilled in the art

to confirm, by measuring the Raman spectrum, whether only a low-dimensional quantum structure having a specific density of state has been selectively oxidized and removed. On the other hand, the Examples in Applicants' original specification show that the Raman spectrum at a wavelength of the irradiated electromagnetic wave is measured to confirm whether the low-dimensional quantum structure having the specific density of state is selectively oxidized and removed.

As illustrated in FIG. 8(b) of Applicants' original drawings, in a case where oxidation is carried out by the method according to claim 1 of the present application, when the Raman spectrum at the wavelength of the laser beam being irradiated is measured, a reduction in a Raman intensity is observed in a specific peak but no new peak appears. Thus, with the method of claim 1 of the present application, it is possible to not just confirm the oxidation of the carbon nanotube, but it is also possible to confirm that the oxidized carbon nanotube has been completely removed.

In sum, Bokova (individually or in combination with Irle) neither discloses nor suggests **selectively oxidizing and removing** a low-dimensional quantum structure of a specific density of state from a mixture of low-dimensional quantum structures of densities of states "**resonating with a wavelength**" of the irradiated electromagnetic wave (by irradiating the low-dimensional quantum structure with an electromagnetic wave having an energy density of 10 kW/cm^2 for two hours). As also noted above, Irle neither discloses nor suggests confirming, by measuring a Raman spectrum, whether only the low-dimensional quantum structure having the specific density of state is selectively oxidized and removed. Therefore, even if the teaching of Bokova is combined with that of Irle, a person ordinarily skilled in the art would not have arrived at the method according to claim 1 of the present application.

For at least the reasons above, a *prima facie* case of obviousness cannot be established with regard to claim 1. Consequently, a *prima facie* case of obviousness also cannot be established with regard to claims 3-6, 11, 13-14, and 16-18, at least by virtue of their dependency from claim 1. The rejection with regard to claims 2, 9-10, 12, and 15 have been rendered moot by the cancellation of those claims. Accordingly, Applicants respectfully request the Examiner to reconsider and withdraw the above rejection.

CONCLUSION

In view of the above, Applicants respectfully request the allowance of all the pending claims in the present application.

Should there be any outstanding matters that need to be resolved in the present application, the Examiner is respectfully requested to contact Alex C. Chang, Reg. No. 52,716, at the telephone number below.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 08-0750 for any additional fees required under 37 C.F.R. § 1.16 or under 37 C.F.R. §1.17; particularly, extension of time fees.

Respectfully submitted,

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